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GRS Color Light & Position Light SIGNALS

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GRS Color Light & Position Light SIGNALS

BULLETIN 144
OCTOBER, 1925

GENERAL RAILWAY SIGNAL COMPANY
ROCHESTER, N.Y., U.S.A.

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GRS Color Light & Position Light Signals

THE development of the light signal has been rapid during the last five years and the practical results obtained have surprised many signal engineers who were of the opinion that the daylight indication of this type of signal could never be made sufficiently effective for high-speed steam railroad service.

The desire to eliminate moving parts wherever possible and to simplify the installation, maintenance and operation of signal systems,—the desire to secure a signal that will give the same indications both day and night, the same indications in tunnels as in the open,—a signal that can be installed on bridges, special structures, in terminals and other places where clearances are limited,—a signal that is well adapted to steam and electric railways alike or to steam railways partly electrified, has led manufacturers and users to turn to the light signal as offering such possibilities.

How well the light signal meets the above named requirements is left to our customers to judge, as it is not our purpose here to discuss the relative merits

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of the light signal as compared to the semaphore type but to provide information concerning color-light and position-light signals which we manufacture.

It might be well to pause for a moment and ask the question, "What are the developments that are responsible for the practical results obtained in the use of the light signal and why is one light signal any better than another?" The building of improved concentrated filament lamps and improved lenses has contributed much, but the greatest improvements have come through the use of accurate methods of construction and focusing. To build a light signal that will give and maintain a satisfactory daylight indication under service conditions, i. e., a signal in which lamps, lenses and other parts may be replaced without the necessity of making focal adjustments in the field, a signal that will be free from phantom indications, is no simple matter. Lamps must be rebased, receptacles built and placed, lens units and signal units assembled,—all with an extreme degree of accuracy only possible where special and adequate facilities are maintained for the purpose.

G-R-S Long-range Color-light Signals are supplied in three types, namely:

(a) The Type "D" or "Vertical Type" which has light units arranged vertically.

(b) The Type "E" or "Horizontal Type" which has light units arranged horizontally.

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(c) The Type "G" or "Triangular Type" which has light units arranged triangular fashion.

G-R-S Short-range Color-light Signals are supplied in two types, namely:

(a) The Type "F" which is similar to the Type "D" Signal, except smaller in size, and which is recommended for short-range daylight indication.

(b) The Type "A" or Subway Type which may also be equipped to give a daylight indication of short range.

The Types D, E, G and F Signals take the same incandescent lamp which is a single-contact, rebased lamp with a three-pin medium bayonet base, and a P. S. 16 bulb having a light center length of $2\frac{3}{16}$ inches.

The Type "A" or Subway Type takes a medium screw-base lamp with either an S-14 or a G-$16\frac{1}{2}$ bulb with a light center length of $2\frac{5}{16}$ inches.

Position-light signals are furnished in two types, namely: the Type "B" which is used as a high signal and the Type "C" which is designed for use as a dwarf signal.

The color-light and position-light signals differ in construction and use, therefore, we will first consider the color-light signal and some of the features that are common to our several types of signals.

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Color-Light Signals

The semaphore signal is a color-light signal at night, therefore, many years of time have been consumed in working out the color indications necessary to operate a modern railroad, especially in securing the standardization of signal indications that now generally prevail. Signal engineers are loath to depart very far from accepted standards as to the meaning and arrangement of color indications.

In the color-light scheme of signaling, as covered in this bulletin, the various indications are given by the use of color only and the position of lights does not enter the scheme, except to secure staggered or vertical red lights to distinguish between absolute and permissive stop signals according to well-known and accepted standards. G-R-S Color-light Signals have no moving parts and give the same indications in the day as in the night. With the lowest wattage lamps listed, the daylight indications have a sufficiently long range in the bright sunlight as to be suitable for average train speeds. Whether the signals are made small for installation in subways or tunnels, where clearances are very limited, or whether they are made standard size for use in the open, the indications are the same; therefore, the color-light signal is well suited to the control of high-speed trains that must operate both on underground and surface tracks.

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Aspects and Indications

While the various types of color-light signals, shown and described in this bulletin and in our Catalog, offer opportunities to provide special indications for various requirements, we have shown, with one or two exceptions, only those indications that are in extensive use.

These standard aspects and indications for each type of signal are shown graphically on pages 19 to 22 inclusive.

A system of reserve indications, as used by the Chicago & North Western Railway, is shown on pages 29 to 31 inclusive and the indications for a combined automatic and train-order signal, as used on the Michigan Central Railroad, are shown and described on page 43.

The indications of an automatic signal equipped with a take-siding indicator are shown on page 46.

The indications used for subway signaling differ in some cases from standard indications and on page 39 we have shown a system of subway signal indications as used by the Brooklyn Manhattan Transit Company.

Reserve Indications

It is the opinion of many signal engineers that where single-filament lamps are used in color-light signaling, reserve indications should be provided, but

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where double-filament lamps are used these reserve indications are not necessary. It is desirable to so control and arrange the indications of each signal that the burning out of a lamp will not cause the signal to give a more favorable indication than it would with the lamp burning,—rather the burning out of a lamp should cause the signal to give a more restrictive indication.

For example, an automatic signal which normally shows a green or proceed indication can easily be arranged, by the use of a cut-in relay, to display a yellow or caution indication when the light for the green indication burns out. An automatic signal which normally shows a yellow or caution indication can be arranged to cut in a reserve yellow light when the caution light burns out. Unit type construction, as used in the types D, E and F signals, makes it a simple matter to provide reserve indications wherever desired.

Circuits, showing the control of a signal with a relay for cutting in reserve indications, are shown on page 28.

Marker Lights

The same reasons exist for the use of marker lights on all automatic color-light signals as for any other type of automatic signal, and we believe that it is better practice to use marker lights on permissive signals than to omit them. It is our opinion that the indication given by a marker light should be equally

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as good as that given by the signal unit, therefore, we recommend that a one-indication type D unit mounted on an adjusting bracket be used where marker lights are required with long-range signals. We can, however, furnish a small 5-inch doublet-lens marker lamp which fits the A. R. A. standard bracket for marker lamps.

Alignment

The color-light signal gives its most satisfactory indications when located in the natural line of vision of the engineer in the cab, therefore, the matter of alignment with the track is of utmost importance. It is also desirable when possible to locate the lower lens of the signal at or near the level of the engineer's eye or at a height of 12 to 14 feet above the rail.

In all of the types of long-range color-light signals described in this bulletin, an adjusting bracket, as illustrated in figure 1, is regularly included as a part of each signal unit. This bracket, with a peep-sight in the signal unit, enables one man to easily and accurately make any adjustments required for alignment. Course adjustments are made when mounting the signal unit and accurate adjustments are made with the adjusting bracket which provides for tilting the unit 5 degrees up or down and for a turning movement of 10 degrees to either side. The manipulation of the bracket will be apparent from the illustration, figure 1.

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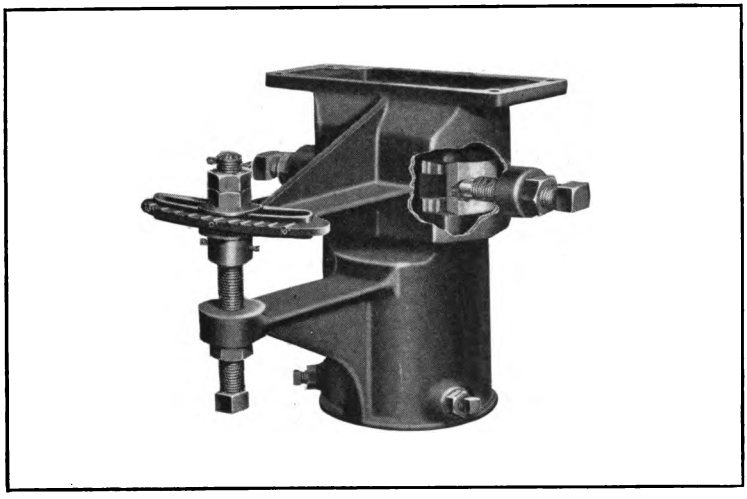

Figure 1 Adjusting Bracket

Back Lights

All G-R-S Color-light Signals can be equipped with back lights if desired. A small plano-convex lens is placed in the cover of lamp case and a mirror is used inside the case to project light from the lamp thru this small lens, which has a wide spread, the arrangement being such that the indication of the signal is not affected by light shining thru this opening from the outside.

Doublet-Lens Unit

All types of G-R-S Color-light Signals, except the subway type, are equipped with doublet-lens light units, the construction of which is shown in figure 2.

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The construction of the doublet-lens unit is such that the focal adjustment, which is accurately made in our factory, remains permanent in service, and lamps, lenses, and other parts may be replaced without the necessity of making any focal adjustments. In other words, the matter of correct focal adjustment is not dependent upon the judgment and accuracy of the man who replaces lamps in the field and, therefore, in using this unit, you can be assured that each and every signal will give a uniformly good indication under average maintenance conditions.

The construction of the doublet-lens light unit is shown in figure 2 and is described as follows:

1st. The effective light from both filaments of a tungsten concentrated double-filament lamp is placed in the focal center of a doublet-lens, the outer lens being 8⅜ inches in diameter with a 4-inch focal length and the inner lens 5½ inches in diameter with a ½-inch focal length. Due to the short focus of the inner lens, the lamp is well within the lens which collects practically all of the effective light from the front of the lamp. The bezel rings and cast-iron frame which hold the two lenses are accurately machined, so that when the unit is assembled the lenses will align and be held exactly in their correct positions. The doublet-lens with lamp and lamp receptacle, as shown in figure 2, may be removed as a unit, or either lens or the lamp may be removed and replaced without changing the focal adjustment.

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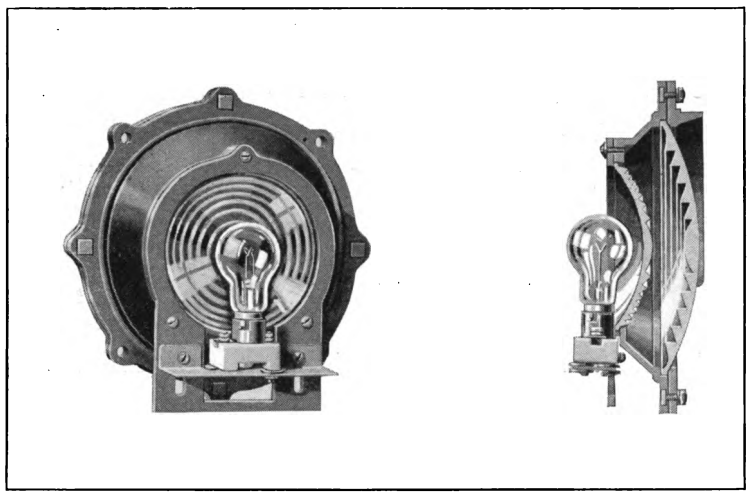

Figure 2 Doublet-Lens Unit

The stepped surfaces of the lenses are totally enclosed in a dust-proof compartment,—only the smooth surfaces are exposed. This makes it very easy to keep the lens surfaces clean and efficient for light transmission.

2nd. The lamp receptacle is jig-set and all lamps rebased by extremely accurate methods to insure that the filament is exactly located in the focal center of the lens, and also to insure that when replacing lamps the filament will always be so located without the necessity of any adjustments.

3rd. The three-pin receptacle and the base used on the lamp are so made that the lamp will not go into the receptacle unless the filament is in the

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correct focal position. The three-pin method of aligning the lamp insures a greater accuracy than can be obtained with two-pin lamps, such as those used in automobile headlights.

The design and construction of the doublet-lens unit is such as to eliminate the possibility of phantom indications, except those of so weak a nature as to be negligible.

Lenses

The outer lens regularly supplied as standard equipment is of clear glass, half toric, to give a beam spread of 3 degrees either side of focal axis and a 20-degree downward spread. (Beam spread is understood to refer to the point, at the angle mentioned, where the intensity of the beam is 50% of the main beam under normal conditions.)

Outer lenses may be furnished, if desired, to give a beam spread of 3 degrees around the focal axis, i. e., without the 20-degree downward spread.

The outer lens is also available in the Spredlite Type which gives a beam spread of 6 degrees to either side of the axial beam. The Spredlite Lens reduces the range about 30% and is used where the track is curved or for highway crossing signals.

Where a beam spread of more than 6 degrees is required, as for example on sharp curves, a Spredlite Lens, giving a spread of 15 degrees to either side of axial beam may be used.

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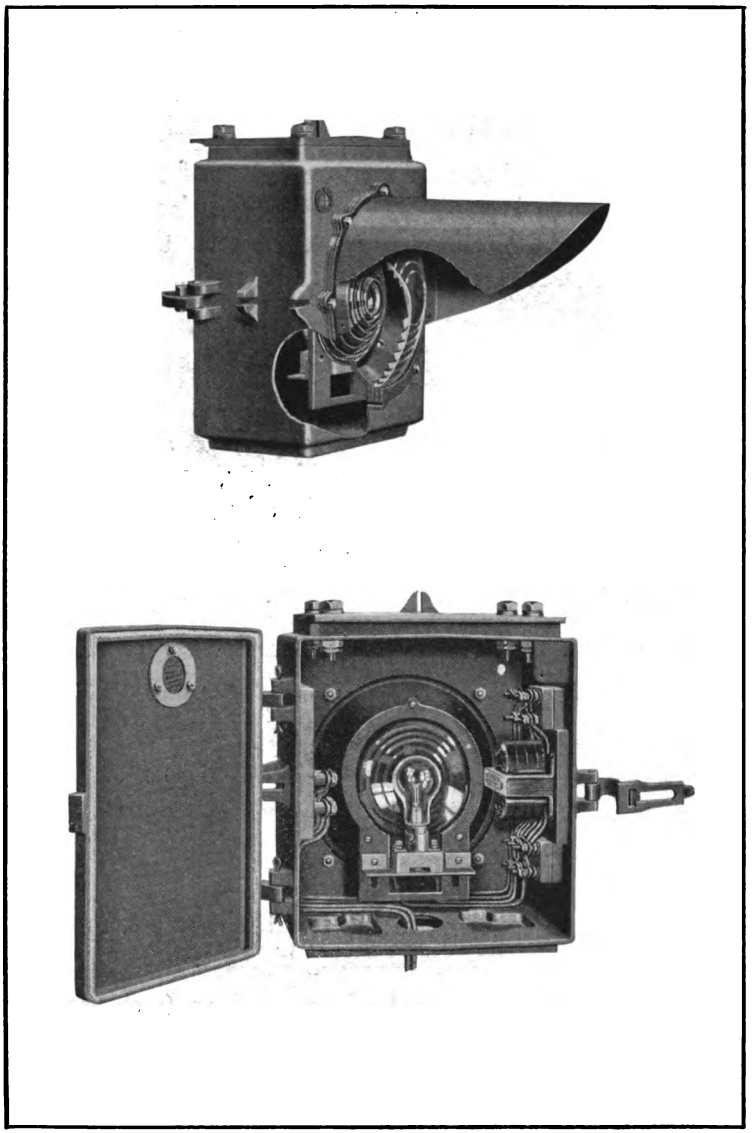

Figure 3 Type D Lamp Case with Doublet-Lens Light Unit

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The inner lens is regularly furnished in red, yellow and green but can be furnished in clear, electric purple or lunar white when specified.

Lamps

Electric lamps regularly supplied for doublet-lens color-light signals are of the tungsten concentrated double-filament, medium bayonet-base, three-pin single-contact type,—rebased and rated as follows:

8 volts, 10 watts
8 volts, 18 watts
10 volts, 18 watts
10 volts, 40 watts
120 volts, 30 watts

We can also furnish a single-filament lamp rated at 10 volts, either 10 or 20 watts, for highway-crossing signals or other purposes as desired. In other respects this single-filament lamp is similar to standard lamps described above.

Range

*R*ange, as applied to the light signals described in the following pages, is understood to mean the distance on a tangent, in bright sunlight, at which the indications are clear and distinct to a person of average eyesight.

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The approximate range of all color-light signals equipped with the 8⅜-inch doublet-lens, previously described, and with each of the lamps regularly supplied is given below:

Lamp Rating		Approximate Range of Signal in Feet
Volts	Watts	
10	40	5000 to 6000
10	18	4000 to 5000
8	18	4000 to 5000
8	10	2500 to 3500
120	30	4000 to 5000

Precautions to Observe When Installing Color-Light Signals

See that all signal units are properly aligned with the track.

Avoid locating signals on curved track but where this is absolutely necessary, see that lenses are used which give sufficient beam spread to properly cover the curve.

The life of the lamp will be materially lengthened if burned about 10% below rated voltage and the indication will not be seriously affected.

Be careful not to burn the lamp at a voltage in excess of the rated voltage. On direct current, if the voltage is likely to exceed the rated voltage of lamp,

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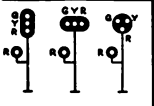
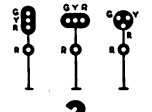
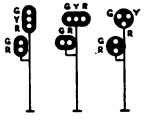
put in a series resistance. On alternating current provide against fluctuation in voltage of supply source.

See that the voltage drop through relay contacts used to control the current to lamp remains uniform and that the proper voltage is supplied to the lamp. Where the source of current supply is alternating current, we recommend that a small transformer be used in each lamp case, since this permits control through relay contacts at 110 volts and provides for accurate voltage adjustment at the lamp.

Provide against drop in control circuits by using wire of sufficient size.

Aspects and Indications
COLOR-LIGHT SIGNALS

Signals	Indication	Characteristics
 1	(G) (R) Proceed	*Automatic—1 Unit (Arm) 3 Indication* with staggered marker used for Permissive Signal—single or double track.
	(Y) (R) Approach next signal prepared to stop	
	(R) (R) Stop then proceed as per rule	
 2	(G) (R) Proceed	*Automatic—1 Unit (Arm) 3 Indication* with vertical marker used for Absolute Signal—single track.
	(Y) (R) Approach next signal prepared to stop	
	(R) (R) Stop	
 3	(G) (R) Proceed	*Automatic—2 Unit (Arm) Top Unit—3 Indication Bottom Unit—2 Indication* used for Approach Signal at Interlocking Plants or Speed Signaling, 3 block indication.
	(Y) (R) Approach next signal prepared to stop	
	(Y) (G) Approach next signal at restricted speed	
	(R) (G) Proceed at restricted speed	
	(R) (R) Stop then proceed as per rule	

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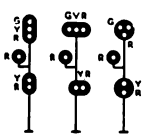
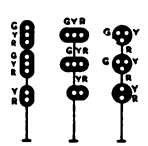
Aspects and Indications
COLOR-LIGHT SIGNALS

Signals	Indication	Characteristics
 **4**	(G) (R) (R) — Proceed	*Automatic—3 Unit (Arm)* *Top Unit—3 Indication* *Center Unit—Fixed Indication* (Staggered Marker) *Bottom Unit—2 Indication* used where Low-speed signal is required in connection with an Automatic Signal to distinguish from an Absolute or Interlocked Signal.
	(Y) (R) (R) — Approach next signal prepared to stop	
	(R) (R) (Y) — Proceed at low speed prepared to stop short of train or obstruction	
	(R) (R) (R) — Stop then proceed as per rule	
 **5**	(G) (R) (R) — Proceed	*Interlocking Signal 3 Unit (Arm)* *Top Unit—3 Indication* for highest speed routes *Center Unit—3 Indication* for medium speed routes *Bottom Unit—2 Indication* for all routes
	(Y) (R) (R) — Approach next signal prepared to stop	
	(R) (G) (R) — Proceed at restricted speed	
	(R) (Y) (R) — Proceed at restricted speed prepared to stop at next signal	
	(Y) (G) (R) — Approach next signal at restricted speed	
	(R) (R) (Y) — Proceed at low speed prepared to stop short of train or obstruction	
	(R) (R) (R) — Stop	

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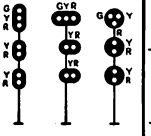
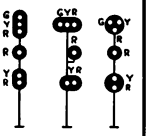
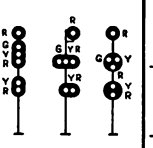
Aspects and Indications
COLOR-LIGHT SIGNALS

Signals	Indication	Characteristics
 **6**	Ⓖ Ⓡ Ⓡ — Proceed	*Interlocking Signal 3 Unit (Arm)* *Top Unit—3 Indication* for highest speed routes *Center Unit—2 Indication* for medium speed routes. *Bottom Unit—2 Indication* for all routes.
	Ⓨ Ⓡ Ⓡ — Approach next signal prepared to stop	
	Ⓡ Ⓨ Ⓡ — Proceed at restricted speed prepared to stop at next signal	
	Ⓡ Ⓡ Ⓨ — Proceed at low speed prepared to stop short of train or obstruction	
	Ⓡ Ⓡ Ⓡ — Stop	
 **7**	Ⓖ Ⓡ Ⓡ — Proceed	*Interlocking Signal 3 Unit (Arm)* *Top Unit—3 Indication* for high speed routes. *Center Unit—Fixed Indication* (Vertical Marker) *Bottom Unit—2 Indication* for all routes.
	Ⓨ Ⓡ Ⓡ — Approach next signal prepared to stop	
	Ⓡ Ⓡ Ⓨ — Proceed at low speed prepared to stop short of train or obstruction	
	Ⓡ Ⓡ Ⓡ — Stop	
 **8**	Ⓡ Ⓖ Ⓡ — Approach next signal at restricted speed	*Interlocking Signal 3 Unit (Arm)* *Top Unit—Fixed Indication* *Center Unit—3 Indication* for medium speed routes. *Bottom Unit—2 Indication* for all routes.
	Ⓡ Ⓨ Ⓡ — Proceed at restricted speed prepared to stop at next signal	
	Ⓡ Ⓡ Ⓨ — Proceed at low speed prepared to stop short of train or obstruction	
	Ⓡ Ⓡ Ⓡ — Stop	

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Aspects and Indications
COLOR-LIGHT SIGNALS

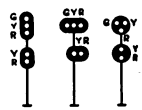
Signals	Indication		Characteristics
	Ⓖ Ⓡ	Proceed	*Interlocking Signal* *2 Unit (Arm)* *Top Unit—3 Indication* for highest speed routes. *Bottom Unit—2 Indication* for low speed routes.
	Ⓨ Ⓡ	Approach next signal prepared to stop	
	Ⓡ Ⓨ	Proceed at restricted speed prepared to stop at next signal or Proceed at low speed prepared to stop short of train or obstruction	
9	Ⓡ Ⓡ	Stop	
	Ⓨ	Proceed at low speed prepared to stop short of train or obstruction	*Interlocking Dwarf Signal* *1 Unit—2 Indication*
10	Ⓡ	Stop	
	Ⓖ	Proceed at restricted speed	*Interlocking Dwarf Signal* *1 Unit—3 Indication*
	Ⓨ	Proceed at low speed prepared to stop short of train or obstruction	
11	Ⓡ	Stop	

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Figure 4 *Type D Color-Light Signals*
Great Northern Railway

Type D Color-Light Signal

THE vertical arrangement of light units and unit construction throughout are features which distinguish the Type D Signal from the others shown. It is a long-range signal having 8⅜-inch doublet-lens units, each lens unit being contained in a separate case and the cases simply bolted together one above the other. Accurate alignment of the different lens units is secured by machining the abutting surfaces of the cases and by assembling them on a jig plate.

The design and construction of the Type D Signal Unit is illustrated in figures 3, 4 and 5.

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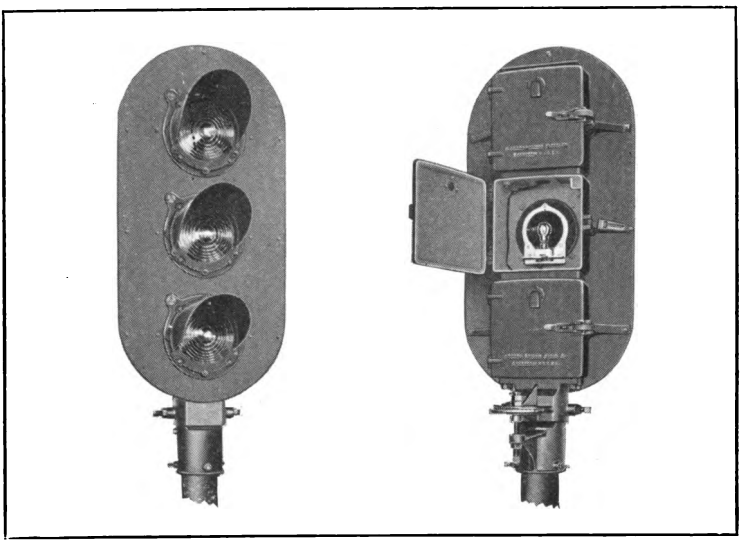

Figure 5 Type D Three-Indication Color-Light Signal Unit

The unit construction of this signal reduces to a minimum the number of parts necessary for a railroad to carry in stock and simplifies the matter of adding or changing indications after installation. For example, a change from a system employing two-indication signals to a system employing three-indication signals is made by simply bolting on another case containing an additional light unit. Special indications, as for example, take-siding indicators or train-order indications and the like, may be easily added by using individual light units as required, with the advantage that these units will be duplicates of those used regularly in the signal system.

Two or more Type D Three-indication Signal Units can be bracket mounted on the same mast

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with a spacing of six feet and six inches between red lenses of each unit, or where the top unit is mounted on top of mast the spacing can be less than six feet between the red lens of this unit and the red lens of the unit below it.

The case containing each doublet-lens unit is large cnough to accommodate a Type K, size ½ Transformer and where the source of current supply is alternating current, we recommend that a transformer be used in each lamp case.

The Type D Color-light Signal is shown in our Electric Signal Appliance Catalog, Volume 1, Section H, Part 21. For convenience, we have included on page 61 of this bulletin a list of catalog references to light signals and closely allied materials.

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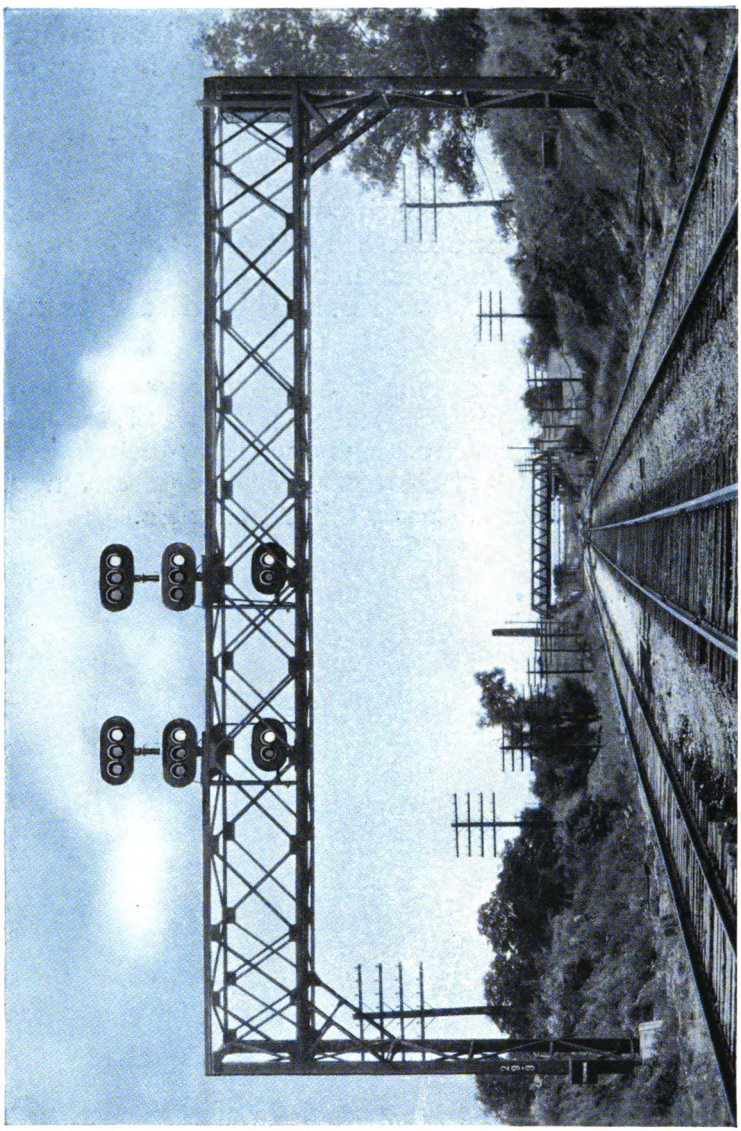

Figure 6 *Type E Color-Light Signals*
Chicago and North Western Railway

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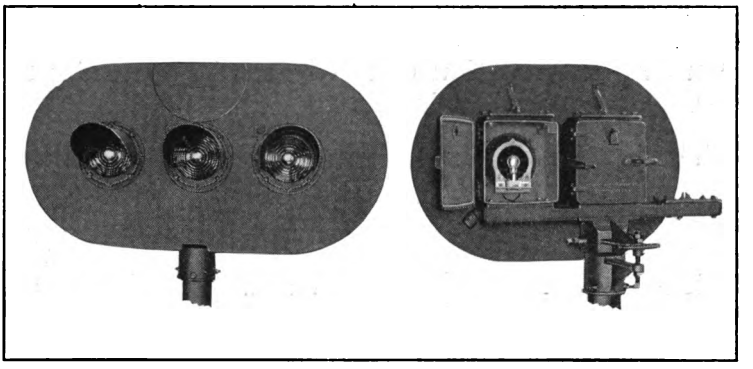

Figure 7 Type E Color-Light Signal Units

Type E Color-Light Signal

THE horizontal arrangement of light units in the Type E Signal gives the advantage of close spacing between signal units on the same mast, which is a very desirable feature when locating signals on bridges, especially where each signal consists of two or more three-indication signal units.

The features of unit construction incorporated in the Type D Signal are retained in this signal, in fact, the light unit with its individual case is identically the same for both types. These cases are bolted to a simple support which is mounted on an adjusting bracket, as shown in figure 7.

The horizontal arrangement of color indications permits the use of a wide variety of automatic signal indications with standard units mounted in the regular way, since an automatic signal consisting of two

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or more three-indication units can be used and distinguished from a similar interlocking signal by changing the location of red lenses in the units to secure staggered red indications.

The horizontal arrangement of light units has the further advantage of providing reserve indications in a convenient and simple manner, if this is desired. A system of reserve indications as used by the Chicago and North Western Railway is shown on pages 29, 30, and 31 of this bulletin, and figure 8 shows the circuits employed.

The Type E Color-light Signal is shown in our Catalog E, Volume 1, Section H, Part 22.

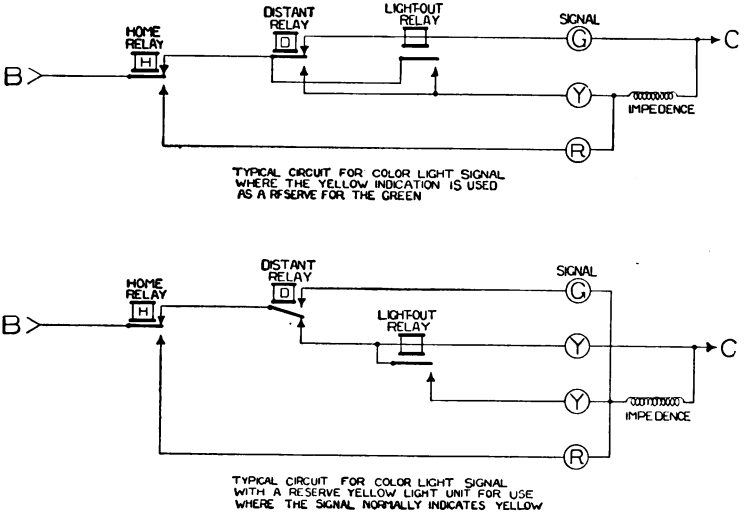

Figure 8 *Circuits for Reserve Indications Type E Color-Light Signal*

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Aspects and Indications
TYPE E COLOR-LIGHT SIGNALS
With Reserve Indications as Used by C. & N. W. Ry.

Signal	Indication		Characteristics
	Ⓖ	Proceed	***Automatic—1 Unit (Arm)*** ***3 Indication*** ***No Reserve Light Unit*** Used where green is the normal indication. Yellow used as reserve for green. Requires 1 light-out relay.
	Ⓨ	Approach next signal prepared to stop	
1	Ⓡ	Stop then proceed as per rule	
	Ⓖ	Proceed	***Automatic—1 Unit (Arm)*** ***3 Indication with*** ***Reserve Yellow Light Unit*** Used where yellow is the normal indication. Requires 1 light-out relay.
	Ⓨ	Approach next signal prepared to stop	
2	Ⓡ	Stop then proceed as per rule	
	Ⓖ Ⓡ	Proceed	***Automatic—2 Unit (Arm)*** ***Top Unit—3 Indication with Reserve Yellow Light Unit*** ***Bottom Unit—2 Indication with Reserve Red Light*** 2 light-out relays required Red lights staggered For use where normal indication is yellow over green. (Approach signal for interlocking).
	Ⓨ Ⓡ	Approach next signal prepared to stop	
	Ⓨ Ⓖ	Approach next signal at restricted speed	
	Ⓡ Ⓖ	Proceed at restricted speed	
3	Ⓡ Ⓡ	Stop then proceed as per rule	
	Ⓖ Ⓡ Ⓡ	Proceed	***Automatic—3 Unit (Arm)*** ***Top Unit—3 Indication*** ***Center Unit—Fixed Indication*** (Staggered Marker) ***Bottom Unit—2 Indication*** for use where a low speed automatic signal is required. Top Unit uses Yellow as reserve for the green. Requires 1 light-out relay.
	Ⓨ Ⓡ Ⓡ	Approach next signal prepared to stop	
	Ⓡ Ⓡ Ⓨ	Proceed at low speed prepared to stop short of train or obstruction	
4	Ⓡ Ⓡ Ⓡ	Stop then proceed as per rule	

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Aspects and Indications
TYPE E COLOR-LIGHT SIGNAL
With Reserve Indications as Used by C. & N. W. Ry.

Signal	Indication		Characteristics
5	(G) (R) (R)	Proceed	*Automatic—3 Unit (Arm)* *Top Unit—3 Indication* with Reserve Yellow Light Unit *Center Unit—Fixed Indication* (Staggered Marker) *Bottom Unit—2 Indication* for use Where the normal indication is yellow and where a low speed signal is required. Requires 1 light-out relay.
	(Y) (R) (R)	Approach next signal prepared to stop	
	(R) (R) (Y)	Proceed at low speed prepared to stop short of train or obstruction	
	(R) (R) (R)	Stop then proceed as per rule	
6	(G) (R) (R)	Proceed	*Interlocking Signal 3 Unit (Arm)* *Top Unit—3 Indication* for highest speed routes *Center Unit—3 Indication* for medium speed routes *Bottom Unit—2 Indication* low speed for all routes No reserve lights, no light-out relays required.
	(Y) (R) (R)	Approach next signal prepared to stop	
	(Y) (G) (R)	Approach next signal at restricted speed	
	(R) (G) (R)	Proceed at restricted speed	
	(R) (Y) (R)	Proceed at restricted speed prepared to stop at next signal	
	(R) (R) (Y)	Proceed at low speed prepared to stop short of train or obstruction	
	(R) (R) (R)	Stop	

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Aspects and Indications

TYPE E COLOR-LIGHT SIGNAL
With Reserve Indications as Used by C. & N. W. Ry.

Signal	Indication		Characteristics
	Ⓖ Ⓡ Ⓡ	Proceed	*Interlocking Signal* *3 Unit (Arm)* *Top Unit—3 Indication* for highest speed routes *Center Unit—Fixed Indication* (Vertical Marker) *Bottom Unit—2 Indication* for all routes No reserve lights, no light-out relays required.
	Ⓨ Ⓡ Ⓡ	Approach next signal prepared to stop	
	Ⓡ Ⓡ Ⓨ	Proceed at low speed prepared to stop short of train or obstruction	
7	Ⓡ Ⓡ Ⓡ	Stop	
	Ⓖ Ⓡ	Proceed	*Interlocking Signal* *2 Unit (Arm)* *Top Unit—3 Indication* *Bottom Unit—Vertical Marker* No reserve lights, no light-out relay required. or Automatic Absolute Signal with Yellow used as reserve for green. 1 light-out relay required.
	Ⓨ Ⓡ	Approach next signal prepared to stop	
8	Ⓡ Ⓡ	Stop	
	Ⓡ	Stop	*Interlocking Dwarf Signal* *1 Unit—2 Indication*
9	Ⓨ	Proceed at low speed prepared to stop short of train or obstruction	
	Ⓨ	Proceed at low speed prepared to stop short of train or obstruction	*Automatic Dwarf Signal* *1 Unit—2 Indication*
10	Ⓖ	Proceed at restricted speed	
	Ⓡ	Stop	*Interlocking Dwarf Signal* *1 Unit—3 Indication*
	Ⓨ	Proceed at low speed prepared to stop short of train or obstruction	
11	Ⓖ	Proceed at restricted speed	

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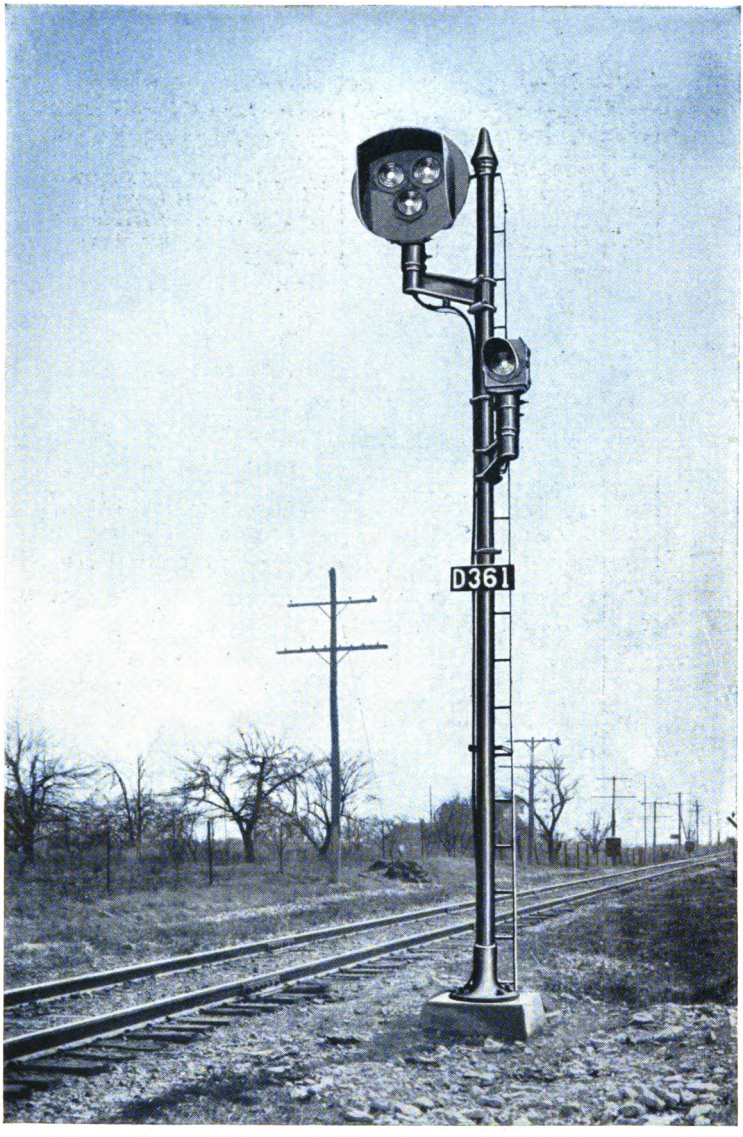

Figure 9 *Type G Color-Light Signal*
Michigan Central Railroad

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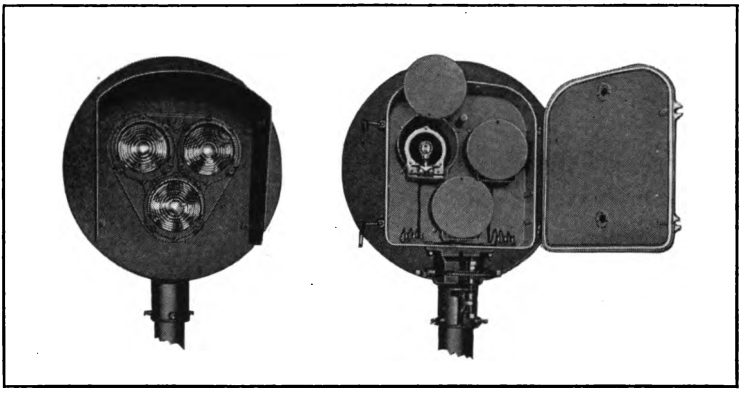

Figure 10 Type G Three-Indication Color-Light Signal Unit

Type G Color-Light Signal

THE compact, triangular arrangement of 8 3/8-inch doublet-lens units in this signal makes it comparatively small in size and well suited for use where clearances are limited or where close spacing between signal units on the same mast is desired. The general construction of the Type G Signal Unit is shown in figure 10. The main case for the unit is cast in one piece rectangular in shape, approximately 25 inches wide by 27 inches high. The lamp of each lens unit is completely shielded by an inner sheet-metal case as shown in the rear view, figure 10. A circular background three feet in diameter is regularly supplied on all signal units but this background may be omitted, if desired. A single hood for the three indications is regularly supplied but individual hoods for each lens unit may be furnished, if desired.

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The Type G Signal has a hinged and chained door which may be swung open if the unit is mounted on top of mast or may be lifted from its support and dropped down to the side where clearances will not permit the door to swing open.

The signal is equipped with a sight which is located slightly above the two upper lens units as shown in the illustration, Fig. 10.

Back lights are not regularly included as a part of the unit but can be supplied if desired.

The color and arrangement of light units may be as desired but we recommend the arrangement as shown for this type of signal on pages 19, 20, 21, and 22 which give the aspects and indications.

The Type G Color-light Signal is shown in our Catalog E, Volume 1, Section H, Part 23.

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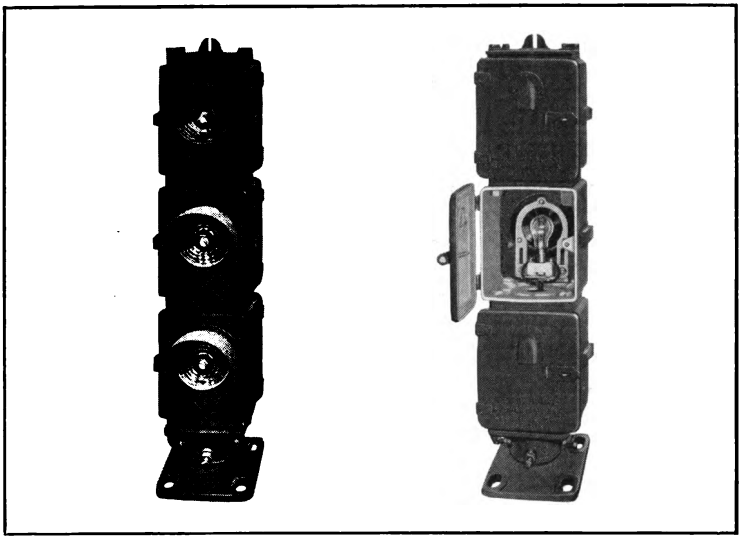

Figure 11 Type F Three-Indication Color-Light Dwarf Signal

Type F Color-Light Signal

THE Type F Color-light Signal is of the same construction as the Type D Signal, formerly described, but is made smaller in size for use where clearances will not permit the installation of the larger size unit. It is an efficient short-range signal that is particularly well adapted to electric railways either of the elevated, surface or subway type. It is also being used extensively as a dwarf signal on steam railways. Figure 11 shows front and rear views of this signal mounted as a dwarf signal and gives a good idea of its construction.

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Lens Units

The Type F Signal has 5-inch doublet-lens units which, except for size, are exactly similar to the 8⅜-inch doublet-lens units formerly described. The outer clear lens is 5 inches in diameter and the inner colored lens is 3⅝ inches in diameter. The lens unit employs lamps of the same size and rating as used in the 8⅜-inch doublet-lens. The lenses are furnished in the same colors and to give approximately the same spread as previously described for the larger unit.

Range

The range of the Type F Signal equipped with lamps as regularly supplied is as follows:

Lamp Rating		Approximate Range of Signal in Feet
Volts	Watts	
10	40	3000 to 3500
10	18	2000 to 2500
8	18	2000 to 2500
8	10	1000 to 1500
120	30	2000 to 2500

Alignment

The Type F Signal is not regularly furnished with the adjusting bracket illustrated in figure 1 but can be arranged for use with this bracket, if desired. A mounting socket, as shown in figure 12, is regularly

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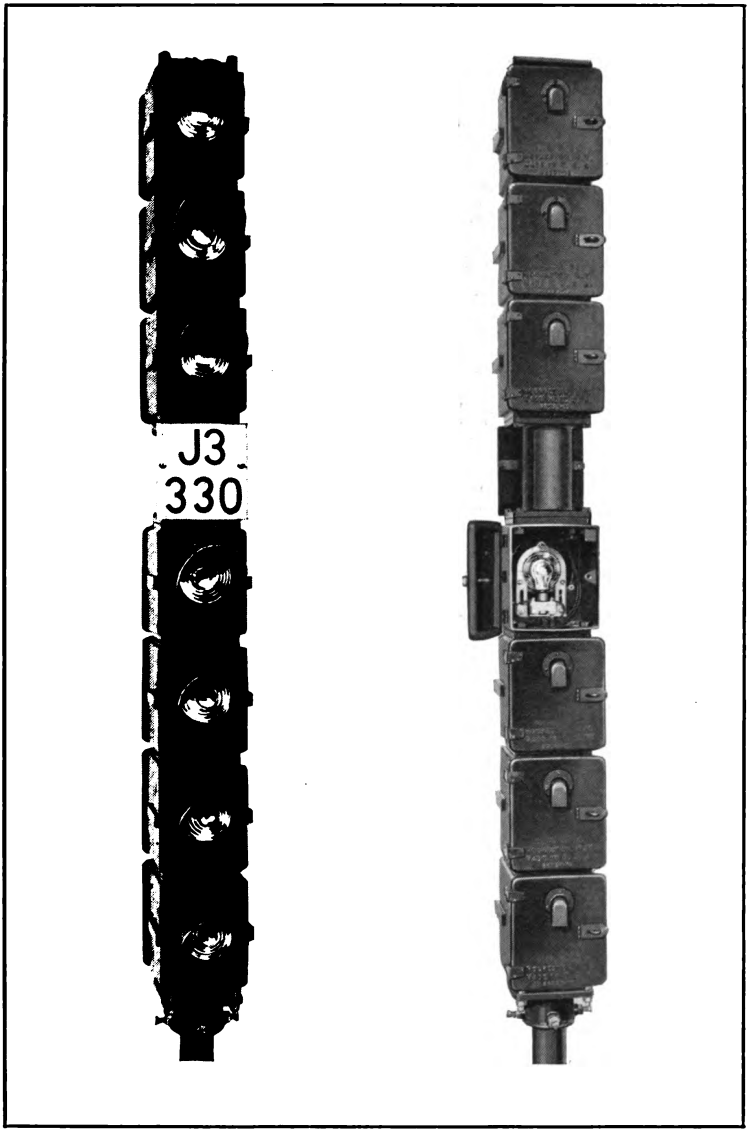

Figure 12 Type F Color-Light Interlocking Signal

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furnished where the unit is to be mounted on top of 2½-inch pipe. Adjustments for alignment with the track are made by manipulating this mounting socket as follows: The unit is turned to either side by turning the mounting socket on the pipe and is tilted up or down by lowering two adjusting cap screws and tightening the other two or vice versa.

Where the unit is used as a dwarf signal, it is simply mounted on a short, adjustable base, and is usually tilted backward at an angle of 8 to 10 degrees to give a good close-up indication.

The Type F Signal may be used for giving standard aspects and indications, as shown on pages 19 to 22 or for giving indications particularly adapted to subway signaling, as shown on page 39. Figure 12 shows a Type F Signal arranged as an interlocking signal for use on an electric railway. The signal is shown in our Catalog E, Volume 1, Section H, Part 24.

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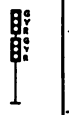
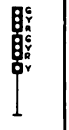
Aspects and Indications
SUBWAY SIGNALING TYPE F AND SHORT-RANGE COLOR-LIGHT SIGNALS

Signal	Indication		Characteristics
1	Ⓖ	Proceed	*Automatic—1 Unit (Arm) 3 Indication*
	Ⓨ	Approach next signal prepared to stop	
	Ⓡ	Stop then proceed as per rule	
 **2**	Ⓖ Ⓡ	Proceed over main route	*Interlocking Signal 2 Unit (Arm)* *Top Unit—3 Indication* for Main Route *Lower Unit—3 Indication* for Diverging Routes
	Ⓨ Ⓡ	Approach next signal over main route prepared to stop	
	Ⓡ Ⓖ	Proceed over diverging route	
	Ⓡ Ⓨ	Approach next signal over diverging route prepared to stop	
	Ⓡ Ⓡ	Stop	
 **3**	Ⓡ Ⓡ Ⓨ	Indications same as in Fig. 2 except as follows: Proceed at low speed prepared to stop short of train or obstruction	*Interlocking Signal 3 Unit (Arm)* *Top Unit—3 Indication* for Main Route *Center Unit—3 Indication* for Diverging Routes *Lower Unit—1 Indication* for all Routes
4	Ⓨ	Proceed at low speed prepared to stop short of train or obstruction	*Interlocking Dwarf Signal 2 Indication* for all Routes
	Ⓡ	Stop	

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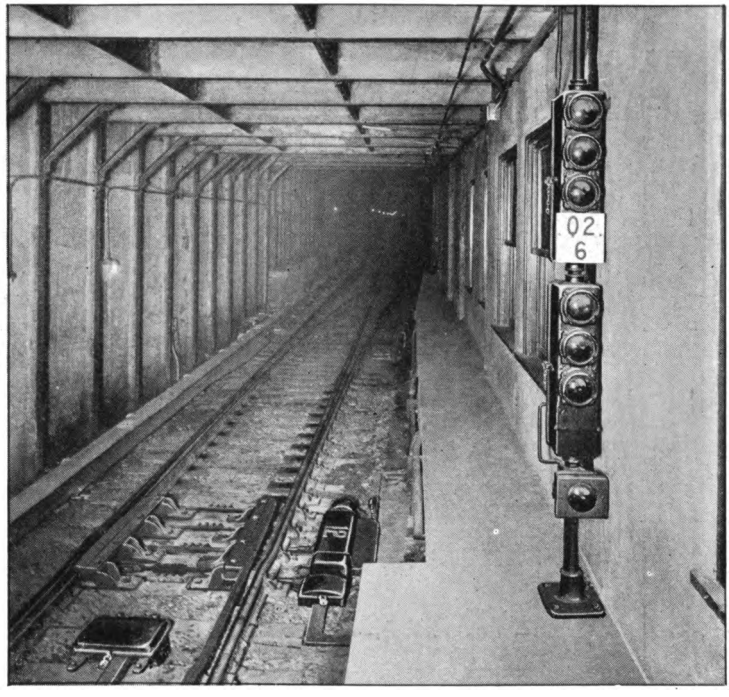

Figure 13 Type A Color-Light Signal Brooklyn Manhattan Transit Co

Type A Color-Light Signal

(SUBWAY TYPE)

ALTHOUGH this signal is especially designed for subway signaling, it is suitable, when equipped with doublet lenses, for daylight locations where a short-range signal is all that is desired. The signal is made as small as possible for use where clearances

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are very limited, the case for a three-indication unit being cast in one piece 2 feet, 7½ inches high by 8 inches wide by 10 inches deep.

When furnished for use in tunnels, train sheds, etc., the signal is equipped with single 5-inch colored standard optical lenses and concentrated double-filament lamps of the medium screw-base type, rated at 14 volts, 10 watts.

When furnished for daylight indication, the signal is equipped with 5-inch doublet lenses and concentrated double-filament lamps of the medium screw-base type, rated at 14 volts, 30 watts or 120 volts, 30 watts. The outer lens is 5 inches in diameter of clear glass and the inner lens is 3⅝ inches in diameter of colored glass. Hoods are provided and, if roadway clearances permit, backgrounds may be used. The lamps are not rebased but the lamp receptacles are adjustable so that in replacing lamps, the lamp filament may be placed in the focal center of the lens.

The range of this signal, when equipped for daylight indication as described, is approximately 1000 feet.

Aspects and indications that have proven well adapted to subway signaling are shown on page 39 and the signal is shown in our Catalog E, Volume 1, Section H, Part 25.

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Figure 14 *Combination Train-Order and Automatic Signal*
Michigan Central Railroad

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Combination Train-Order and Automatic Signal

LOGICAL reasons exist for combining the train-order signal with an automatic signal and one road, namely, the Michigan Central Railroad has done this successfully.

The aspects and indications of this signal are given below and the control circuits are shown by figure 15, while the signal itself is shown in figure 14 and on Plate H2308 in our Catalog E, Volume 1. One unit of a table interlocker is used in the station as a combination circuit controller and a three-banner indicator to control and indicate the operation of a signal as follows:

Aspects and Indications of a Combination Automatic and Train-Order Signal as used by Michigan Central R. R.

Signal	Indication	
	Ⓖ Ⓡ	Proceed
	Ⓨ Ⓡ	Approach next signal prepared to stop
	Ⓡ Ⓡ	Stop then proceed as per rule
	Ⓖ Ⓨ	Pick up 19 order and proceed
	Ⓨ Ⓨ	Pick up 19 order and approach next signal prepared to stop
	Ⓡ Ⓨ	Stop, pick up 19 order then proceed as per rule
	Ⓡ Ⓡ	Stop for 31 order

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With the control lever to the left, energy is supplied to triangular signal unit and marker light so that the signal operates simply as an automatic signal and the banner labeled "A" appears, indicating to the operator that an automatic signal is displayed.

With the control lever to the right, the marker light is deprived of energy and energy is applied to the yellow light of the train-order unit. The banner labeled "A" changes to red and the banner labeled "19" appears, indicating to the operator that the signal is displaying a 19-order indication.

With the control lever in the central position, the local winding of the track relay is deprived of energy which causes the automatic signal unit

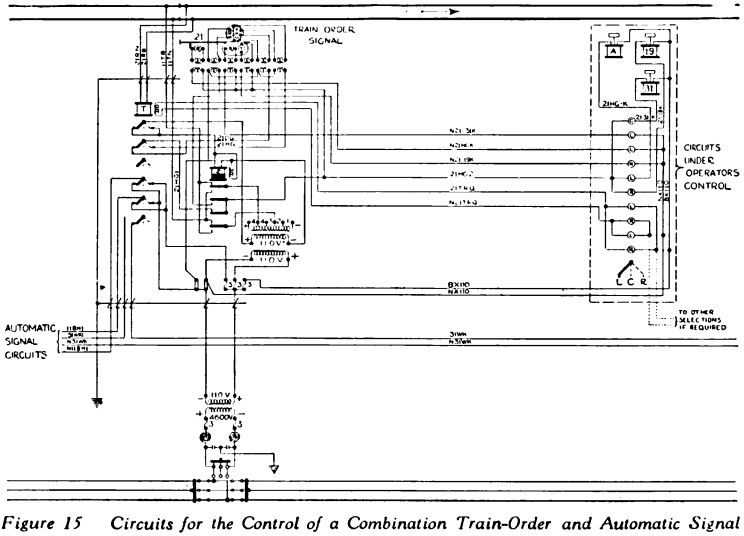

Figure 15 Circuits for the Control of a Combination Train-Order and Automatic Signal

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to display a red indication, the marker light is deprived of energy, and energy is applied to the red light of the train-order unit. Thus the signal displays, in a horizontal line, two red indications which are used to indicate that the train must stop for a 31 order. The operator is informed that this indication is displayed by the appearance of indicator labeled "31," the other two indicators showing red.

It will be noted, by an examination of the circuits figure 15, that energy is supplied to the banner indicators through two lamps in multiple. The indicators are adjusted to pick up and hold up on the current thus supplied, but will not hold up nor pick up on the amount of current received thru one lamp only. Therefore, if a lamp should burn out so that an incomplete or an improper signal would be displayed, the same is indicated to the operator by all indicators showing red.

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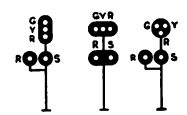
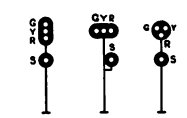
The Take Siding Indicator

THE take siding indicator consists of a regular Type D doublet-lens lighting unit having an inner lens arranged so that the light shows through a letter S frosted on its surface, the remainder of the surface of the lens being opaqued. The indication given is clear and distinct in the daylight at short range.

Although there may be occasion, under some conditions, to locate this indicator on a signal at considerable distance from the siding, we believe that in most cases it is desirable to locate the indicator on a signal at or near the siding and the indications given below are for the latter location.

Aspects and Indications
AUTOMATIC SIGNAL WITH "TAKE-SIDING INDICATOR"

Signals	Indication			Characteristics
	1 with marker light	2 without marker light		
 1	(G) (R)	(G)	Proceed	*Automatic—1 Unit (Arm) 3 Indication* with staggered marker and take-siding indicator Permissive signal.
	(Y) (R)	(Y)	Approach next signal prepared to stop	*Automatic—1 Unit (Arm) 3 Indication* with take-siding indicator. Permissive Signal.
	(R) (R)	(R)	Stop then proceed as per rule	
2	(R) (S)	(R) (S)	Take Siding	

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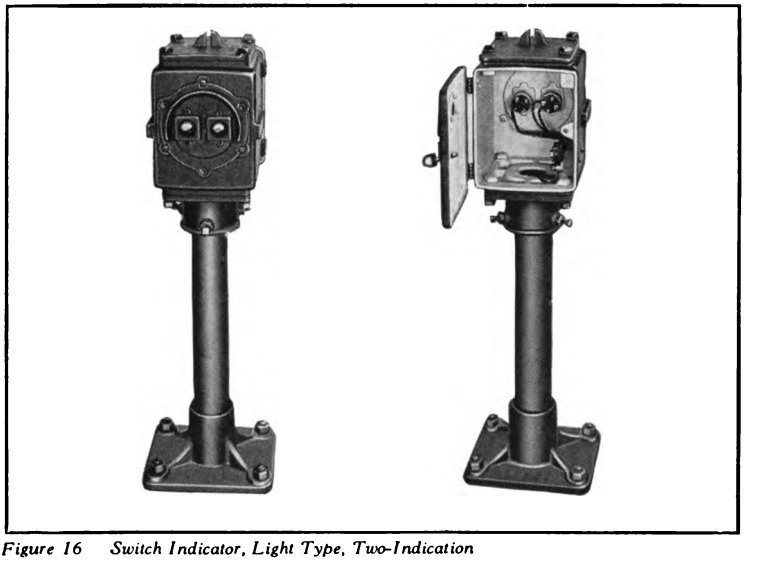

Figure 16 Switch Indicator, Light Type, Two-Indication

Switch Indicators

FOUR kinds of Switch Indicators are available as shown in our Catalog E, Volume 1, Section E, Part 6, Plates E0611, E0613, E0615 and E0617.

One indicator consists of a standard A. R. A. electric lamp case, bracket mounted to a cable or indicator post. It has a yellow roundel protected by a wire-mesh guard and employs a medium screw-base type of lamp.

Another consists of a cast-iron case, the upper portion of which is circular and contains a yellow roundel and the electric lamp. The lower portion

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of the case contains a push-button switch, a small transformer, resistance unit, etc. The case is arranged for mounting on top of a 2½-inch pipe or may be bracket mounted to a 2½-inch pipe. It employs a 12-volt, 9-watt, single-contact, bayonet-base lamp rebased for a two-pin receptacle.

Figure 16 shows a two-indication switch indicator which consists of two bulls-eye type light units mounted in the same lamp case as used in the Type F Signal. This case may be mounted on top of a 2½-inch pipe or may be bracket mounted to a 2½-inch pipe or a rectangular concrete post. The lenses or bulls-eyes are 1½ inches in diameter and are furnished in clear, green, yellow and red. The lamps used are of the minature candelabra bayonet-base or automobile type. The case is sufficiently large to accommodate two small transformers, resistance units, etc.

A four-indication switch indicator of the same general construction as that shown in figure 16 is available. This indicator is a very desirable unit for use on double track at cross-overs. It consists of four bulls-eye type of light units and a double-contact push button mounted in a lamp case of the size used in the Type D Signal. The bulls-eye lenses are 1½ inches in diameter and are usually furnished in red and yellow. Carbon-filament lamps of the miniature candelabra screw-base type, rated at 120 volts, 10 watts, 2 S. C. P. are regularly provided but lamps of other ratings can be furnished if desired. The indicator is furnished with a mounting socket for mounting on top of 4-inch pipe, or by the use of an adapter with this socket, it may be mounted on the same type of bracket as used for the support of a relay box.

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Type K Color-Light Highway-Crossing Signal

THE Type K Color-light Highway-crossing Signal consists of two single light units bracket mounted to a 4-inch post with the light units in a horizontal line 28¾ inches between centers. The signal is usually controlled by means of a flashing relay so that the lights flash alternately at the approximate rate of 30 flashes per minute for each light.

Doublet-Lens Unit

The Type K Signal is regularly equipped with 8⅜-inch doublet-lens units consisting of a Spredlite, clear outer lens which gives a total beam spread of 12 degrees, and an inner 5½-inch red lens. This unit is the same as used in our regular Type D Signal, except for the use of the Spredlite Lens which reduces the range listed on page 18 about 30%.

Current Supply

It is important that the current supply for the operation of flashing-light highway-crossing signals be made as dependable as possible. We, therefore, recommend the use of a storage battery, either on trickle charge from alternating current through a rectifier or floating on primary battery.

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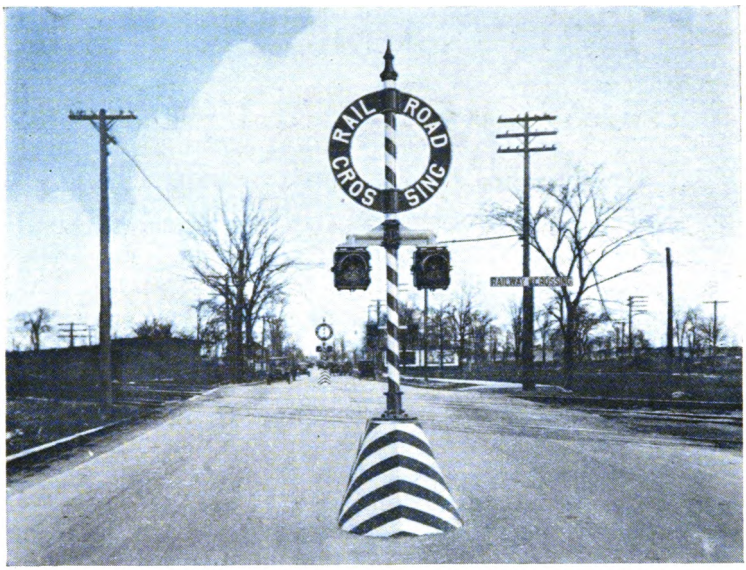

Figure 17 *Type K Color-Light Highway-Crossing Signals Grand Trunk Railway System*

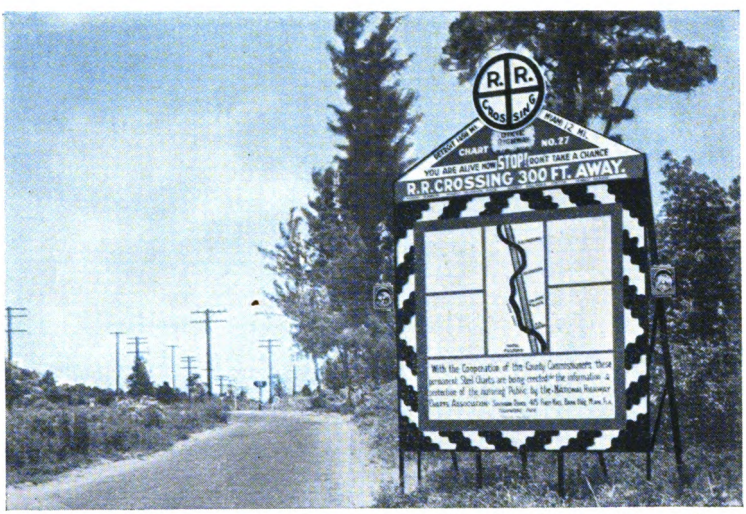

Figure 18 *Type K Color-Light Highway-Crossing Signal used with Highway Charts, Florida East Coast R. R.*

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Figure 17 shows an installation of the Type K Highway-crossing Signal on the Grand Trunk Railway at Detroit, Michigan, and figure 18 shows an installation of this signal in connection with highway charts on the Florida East Coast Railway.

It will be noted from the illustration, figure 17, that the construction is such that the signal units may be easily mounted for use in conjunction with highway-crossing signs, crossing bells, etc.

The Type K Color-light Highway-crossing Signal is shown in our Catalog E, Volume 1, Section H, Part 29.

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Figure 19 Type B Position-Light Signals Pennsylvania Railroad

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Position-Light Signals Types B and C

THE development of the Position-light Signal for high-speed steam railroad service began 11 years ago on the Pennsylvania Railroad and within a comparatively short time the signal had been perfected to such an extent that it was considered highly satisfactory by the operating officials of this road. There are at present several thousand position-light signals in service on the Pennsylvania Lines and other roads have made installations.

In the position-light scheme of signaling, the indications are given entirely by the position of lights, three lights being displayed in a row for each indication of a high signal and two lights in a row for each indication of a dwarf signal, the positions of the row of lights corresponding to the positions of the signal blade in the semaphore method of signaling.

The position-light signal has no moving parts, the indications are the same in the day as in the night and an engineman is not required to determine the color of a signal light. It can be installed anywhere that clearance will permit the use of a semaphore signal.

Aspects and Indications

Typical aspects and indications for the position-light signal are shown on page 54. It will be noted

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Position-Light Signals

Aspects High Signal		Indications
1		Proceed
2		Proceed prepared to stop at next signal
3		Proceed with caution prepared to stop short of train or obstruction
4		Stop
5		Stop and proceed as per rule
6	a b	Proceed prepared to pass next signal at medium speed
7	a b	Proceed at medium speed
8	a b	Proceed at restricted speed prepared to stop at next signal
9	a b	Proceed at low speed prepared to stop short of train or obstruction
Dwarf Signal		
10		Proceed at low speed
11		Proceed at low speed prepared to stop
12		Proceed at low speed prepared to stop short of train or obstruction
13		Stop
14		Take Siding

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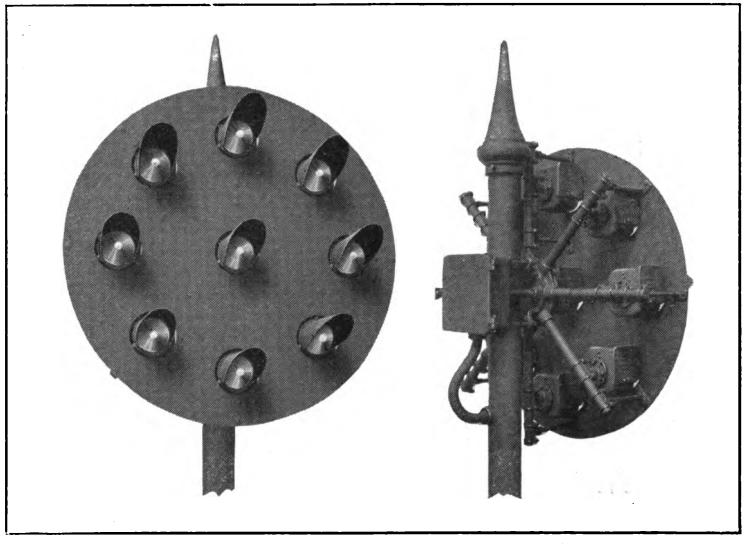

Figure 20 Type B Position-Light Signal Unit

that speed signaling, three-block indication, is obtained by the use of only nine aspects and that these aspects are secured by the use of signals, consisting of only two signal units or arms each. The dwarf signal aspects are listed separately, since with this signal only two lights are displayed in a row, the position of the row of lights, however, is the same as is included with the nine aspects mentioned.

The aspects and indications shown have been in use for a number of years and have proven their practicability in handling high-speed traffic.

Details of Construction

Type B High-Signal Unit

The Type B Position-light Signal Unit or Arm as used on ground, bridge and bracket signals is ar-

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ranged for giving a maximum of four indications. Each lamp is contained in an individual cast-iron lamp case and these lamp cases are bolted to 1¼-inch pipe supports which radiate from a cast-iron hub.

The hub is bolted to a 5-inch mast and a cast-iron terminal box is attached to the opposite side of the mast by the same bolts which hold the hub. The lamps are located on an 18-inch radius about a central lamp and the hoods and lenses of these lamps project through a background, which is attached to the pipe supports by means of substantial brackets. The wires leading to each lamp pass down through the 1¼-inch pipe supports through the hub and a short conduit nipple into the terminal box. From the terminal box, the wires lead into the mast through a flexible conduit connection so that the signal unit may be aligned without disturbing the wiring. The lamp units, terminal box and all parts are easily accessible.

Figure 20 shows a front and rear view of the Type B Position-light Signal Unit and gives a general idea of its construction. The details of construction are shown in our Catalog E, Volume 1, Section H, Part 31, Plates H3107 and H3109.

Lamp Unit

The construction of the Type B Lamp Unit is shown in figure 21. It consists of a lamp, lamp receptacle, an inverted lens, a cover glass and mirror reflector, all contained in a cast-iron case having a cover on one side and includes a mounting bracket and hood. The cover slides on vertically, is easily

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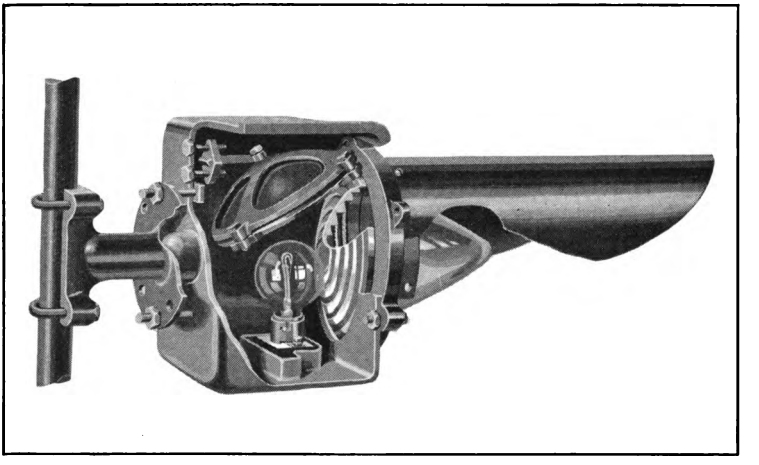

Figure 21 Type B Position-Light Signal Lamp Unit

removed and provides a large opening through which all parts are easily accessible. The mounting bracket is attached to the lamp case through a ball and socket joint and by four bolts which provide for any adjustment required in aligning the lamp.

All lamps are rebased and lamp receptacles are jig-set and cemented in place so that the lamp filament is located in the focal center of the lens and so that lamps may be replaced without the necessity of focal adjustments.

The inverted lens is 5⅜ inches in diameter of clear glass and has a focal length of 2¼ inches. The cover glass used with each lens is conical in shape, is of amber tinted glass and has a frosted tip. The conical shape and frosted tip prevent reflections of sunlight or sunglare and the tinted glass gives a more penetrating beam, especially under foggy

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weather conditions. Phantom indications are further prevented by painting black a lower portion of the lens steps and by using a lamp with the filament located well above the center of curvature. The mirror reflector is adjustably mounted as shown and is used to increase the efficiency of the unit, particularly to give a good close-up indication.

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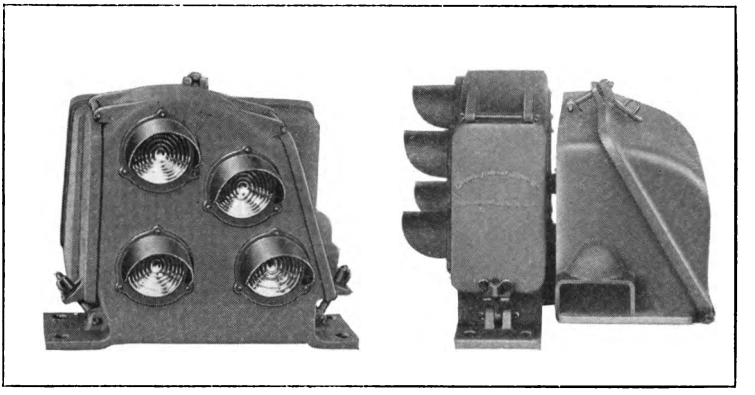

Figure 22 Type C Position-Light Dwarf Signal Unit

Type C Position-Light Dwarf Signal

THE Position-light Dwarf Signal is designed for short range and its construction is entirely different from that of the high signal unit previously described. The case containing the lamps is cast in one piece with a door on either side and is so arranged that a small cast-iron relay box may be bolted on the back. The case is 15½ inches high by 16 inches wide by 9⅜ inches deep and, therefore, may be located where clearances are very limited. The lamps are of the type used in automobile headlights.

The lamp receptacle is bracket mounted to the back of the case but is not jig set nor is the lamp rebased, since accurate methods of focusing are not

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considered necessary for this short-range signal. The lens is 4 inches in diameter, of clear glass and has its outer surface frosted.

The Type C Position-light Dwarf Signal is shown in our Catalog E, Volume 1, Section H, Part 31, Plate H3105.

Lamps

The lamps regularly supplied for Type B Position-light High Signals are rated at 12 volts, 9 watts, 6 S. C. P., have a tungsten, concentrated single filament and are of the medium bayonet-base, single-contact type, rebased for a two-pin receptacle.

The lamps regularly supplied for the Type C Dwarf Signal are of the single, concentrated filament, miniature candelabra, single-contact bayonet-base type, rated at 6.5 volts, 16.9 watts.

Lamps may be furnished rated at 12-16 volts, 17.1 watts.

Range

The range of the Type B Position-light High Signal with the lamp regularly furnished is approximately 2500 to 3000 feet in bright sunlight.

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Catalog References to Light Signals and Accessories

Type D (Vertical) Color-Light Signals

Catalog E, Volume 1, Section H, Part 21

One-Unit, Three-indication, Type D Ground Signals	Plate H2101
Two-Unit, Type D Ground Signals	Plate H2103
Three-Unit, Type D Ground Signals	Plate H2105
Two-Unit, Type D Bridge Signals	Plate H2107
Three-Unit, Type D Bridge Signals	Plate H2109
Two-Unit, Two-Direction, Type D Ground Signal	Plate H2111
Type D Signal Units	Plate H2113
Signal Unit Details for Type D Signals	Plate H2115

Type E (Horizontal) Color-Light Signals

Catalog E, Volume 1, Section H, Part 22

One-Unit, Three-indication, Type E Ground Signals	Plate H2201
Two-Unit, Type E Ground Signals	Plate H2203
Three-Unit, Type E Ground Signals	Plate H2205
Three-Unit, Type E Bridge Signals	Plate H2207
Type E Signal Units	Plate H2209
Signal Unit Details for Type E Signals	Plate H2211

Type G (Triangular) Color-Light Signals

Catalog E, Volume 1, Section H, Part 23

One-Unit, Three-indication, Type G Ground Signals	Plate H2301
Two and Three-Unit, Type G Ground Signals	Plate H2303
Two-Unit, Type G Bridge Signals	Plate H2305
Three-Unit, Type G Bridge Signals	Plate H2307
Combination Automatic and Train-Order Signal	Plate H2308
Type G Signal Units	Plate H2309

Type F (Small Vertical) Color-Light Signals

Catalog E, Volume 1, Section H, Part 24

One and Two-Unit, Three-indication, Type F Signals	Plate H2401
Three-Unit, Type F Signals	Plate H2403
Two-indication, Type F Dwarf Signal	Plate H2405
Three-indication, Type F Dwarf Signal	Plate H2407

(Continued on Page 62)

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Catalog References to Light Signals and Accessories
(Continued)

Type A (Subway Type) Color-Light Signals
Catalog E, Volume 1, Section H, Part 25

One-Unit, Three-indication, Type A Signal	Plate H2501
Three-Unit, Type A Signal	Plate H2503
Two and Three-indication, Type A Signal Units	Plate H2505
Two and Three-indication, Type A Tunnel Signal Units	Plate H2507

Light Type, Switch Indicators
Catalog E, Volume 1, Section E, Plates E0611, E0613, E0615 and E0617.

Color-Light Highway-Crossing Signals
Catalog E, Volume 1, Section H, Part 29

Type K, Two-Unit Flashing, Signals	Plate H2901

Color-Light Signal Details Catalog E, Volume 1, Section H, Part 30

Doublet-Lens Light Units	Plate H3001
Electric Lamp Bulbs for Light Signals	Plate H3011
Electric Lamp Bulbs for Electric Semaphore Lamps	Plate H1911
Marker Lights and Electric Lamps	Plate H2113 and H1905
Lighting Transformers	Plate P0102
Number Plates	Plate H1715

Position-Light Signals Catalog E, Volume 1, Section H, Part 31

One and Two-Unit, Type B Position-Light Ground Signals	Plate H3101
One and Two-Unit, Type B Position-Light Bridge Signals	Plate H3103
Type C Position-Light Dwarf Signal	Plate H3105
Type B Signal Units, Position-Light Signal	Plate H3107
Type B Signal Unit Details	Plate H3109

Miscellaneous Materials

Relay and Instrument Housings	Catalog E, Volume 1, Section E, Part 9
Resistance Units	Catalog E, Volume 4, Section N, Part 13

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Chicago, Illinois

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100 East 42nd Street
New York, New York

2042 Railway Exchange Building
St. Louis, Missouri

Room 412 Matson Building
215 Market Street
San Francisco, California

Associate Companies

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of Canada, Limited
Lachine, Quebec

General Railway Signal Company
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